

## **SECTION 02605**

### **HIGH DENSITY POLYETHYLENE (HDPE) PIPES AND FITTINGS**

#### **PART 1 GENERAL**

##### **1.01 SCOPE**

- A. This Section includes high density polyethylene (HDPE) pipes, fittings, and appurtenances.

##### **1.02 RELATED SECTIONS AND PLANS**

- A. Section 02100 - Surveying
- B. Section 02215 - Trenching and Backfilling
- C. Section 13005 - Liner Penetration Boxes
- D. Part 8 - Environmental Health and Safety, and Training Requirements
- E. Part 9 - Quality Assurance Requirements

##### **1.03 REFERENCES**

- A. Latest version of the American Society for Testing and Materials (ASTM) standards:
  - 1. ASTM D 638. Test Method for Tensile Properties of Plastics.
  - 2. ASTM D 790. Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - 3. ASTM D 1238. Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
  - 4. ASTM D 1248. Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
  - 5. ASTM D 1505. Test Method for Density of Plastics by the Density-Gradient Technique.
  - 6. ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.
  - 7. ASTM D 1693. Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

8. ASTM D 2657. Standard Practice for Heat Joining Polyolefin Pipe and Fittings.
  9. ASTM D 2837. Standard Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
  10. ASTM D 3350. Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
  11. ASTM F 714. Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
  12. ASTM F 1055. Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
- B. Latest version of the American National Standards Institute (ANSI) standards:
1. ANSI B16.1. Standard Specifications for Cast-Iron Pipe Flanges and Flange Fittings.
- C. Latest version of the American Society of Mechanical Engineers (ASME) standard:
1. ASME B31.9 §937.1 through 937.3 Building Services Piping.

#### **1.04 SUBMITTALS**

- A. Submit the following to the Construction Manager for review within 30 calendar days from Notice to Proceed:
1. detailed shop drawings of all HDPE, pipes, support centralizers, fittings, supports, and appurtenances;
  2. a list of materials to be furnished with the names of the suppliers;
  3. detailed procedures to be used for hydrostatic testing of the pipes and fittings including detailed procedures for hydrostatic test interpretation;
  4. origin (resin supplier's name, resin production plant) and identification (brand name, number) of the polyethylene resin used; and
  5. manufacturers' published minimum values and the corresponding test procedures for HDPE material properties listed in Tables 02605-1 of this Section; submit values that are specific to the resin used in manufacture.
- B. Submit to the Construction Manager for review at least 30 calendar days prior to shipment, the following documentation on the HDPE, pipes, fittings, and supports.
1. copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the HDPE products for this Contract to include certification that no reclaimed polymer is added to the resin during the manufacturing of the HDPE products to be used for this project;

2. results of tests specified in Table 02605-1 of this Section conducted by the Manufacturer to verify the quality of the HDPE products assigned to the project; and
  3. Manufacturer's written certification of compliance with this Section for the material to include certification of a final inspection and a written record of this inspection. The inspection shall include the following:
    - a. HDPE pipes, fittings, and appurtenances:
      - i. dimensional check; and
      - ii. material quality check.
- C. Submit at least 14 calendar days prior to installation documentation of training and certification of personnel qualified for performing HDPE pipe joining operations.

## **1.05 HEALTH AND SAFETY REQUIREMENTS**

- A. Environmental, health and safety, and other training requirements shall be as specified in Part 8 of the Contract Documents.

## **PART 2 PRODUCTS**

### **2.01 HDPE COMPOUND**

- A. Furnish HDPE pipe and fittings manufactured from new, high performance, high molecular weight, HDPE resin conforming to ASTM D 1248 (Type III, Class C, Category 5, Grade P34), ASTM D 3350 (minimum Cell Classification as shown in Table 02605-1), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. Furnish material having minimum certifiable property values listed in Table 02605-1.

### **2.02 HDPE PIPES, FITTINGS, AND APPURTENANCES**

- A. Unless otherwise shown on the Construction Drawings, furnish HDPE pipe and fittings that have a Standard Dimension Ratio (SDR) of 11 and conform to ASTM F 714.
- B. Furnish HDPE pipes in standard laying lengths not exceeding 50 feet.
- C. Furnish HDPE pipes and fittings that are homogeneous throughout and free of visible cracks, holes (other than intentional manufactured perforations), foreign inclusions, or other deleterious effects, and are uniform in color, density, melt index, and other physical properties.

- D. Furnish HDPE end caps at the end of pipes as shown on the Construction Drawings.
- E. Furnish electrofusion couplings meeting the requirements of ASTM F 1055 and as recommended by the electrofusion coupling Manufacturer.
- F. Perforate pipe by factory drilling as shown on Construction Drawings.

### **2.03 HDPE DUAL CONTAINMENT PIPING SYSTEM**

- A. Furnish dual containment piping system consisting of field or factory fabricated carrier and containment pipes and pre-fabricated fittings.
- B. Furnish components of the dual containment piping system, including carrier piping, containment piping, fittings, and appurtenances meeting the requirements for HDPE pipes, fittings, and appurtenances given in this Section.
- C. Furnish pipe and fittings with the carrier pipe/fitting ends extending 6.5 inches beyond the containment pipe/fitting ends. Provide pipe in standard laying lengths not exceeding 50 feet, and allow for field adjustment of pipe length.
- D. Furnish pre-fabricated dual containment fittings with the carrier fitting factory installed within the containment fitting, with all necessary support centralizers installed.
- E. Fabricate all carrier to carrier and containment to containment joints using butt fusion procedures recommended by the Manufacturer and as required by this Section. Fabricate carrier to carrier joints and containment to containment joints independently of each other. Inspect carrier to carrier joints before final closure of the containment.
- F. Furnish support centralizers to provide a continuous annular space between the carrier and the containment pipes in conformance with the recommendations of the Manufacturer or with a maximum allowable spacing of 4 feet, whichever is less. Centralizers shall not inhibit flow of carrier pipe leakage in the containment pipe. Material for centralizers shall be as recommended by HDPE pipe manufacturer.

### **2.04 IDENTIFICATION**

- A. Continuously indent print on the HDPE pipe, or space at intervals not exceeding 5 feet, the following:
  - 1. name and/or trademark of the HDPE pipe manufacturer;
  - 2. nominal HDPE pipe size;

3. standard dimension ratio (e.g., SDR-11);
4. the letters PE followed by the polyethylene grade per ASTM D 1248, followed by the Hydrostatic Design Stress in 100's of psi (e.g., PE 3408);
5. manufacturing Standard Reference (e.g., ASTM F 714); and
6. a production code from which the date and place of manufacture can be determined.

## **2.05 EMBEDMENT FILL AND BACKFILL MATERIALS**

- A. Furnish pipe embedment fill materials in accordance with Section 02215.
- B. Furnish backfill materials in accordance with Sections 02215.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Perform HDPE pipe joining operation with trained and certified personnel.
- B. Liner penetration boxes shall be installed in accordance with Section 13005 prior to connection to HDPE piping.

### **3.02 HANDLING OF HDPE PIPE, FITTINGS AND APPURTENANCES**

- A. Deliver HDPE pipe, fittings, and appurtenances to the site at least 10 calendar days prior to the planned installation date.
- B. Provide proper handling and storage of the HDPE pipe, fittings, and appurtenances at the site. Protect materials from excessive heat or cold, dirt, moisture, cutting, or other damaging or deleterious conditions. Provide any additional storage procedures required by the Manufacturer.
- C. Exercise care when transporting, handling, and placing HDPE pipe and fittings. Use rope, fabric, or nylon slings and straps when handling HDPE pipe. Do not position slings, straps, etc., at butt-fused joints or at fittings.
- D. The maximum allowable depth of cuts, gouges or scratches on the exterior surface of HDPE pipe or fittings is 10 percent of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges and scratches. Replace any HDPE pipe and fittings

that become gouged, twisted, or crimped. Remove damaged pipes and fittings from the project site.

- E. Whenever pipe laying is not actively in progress, close the open ends of all installed pipes using watertight plugs.

### **3.03 HDPE PIPE AND FITTINGS INSTALLATION**

#### **A. General:**

1. Examine HDPE pipe and fittings for cracks, damage or defects before installation. Do not use cracked, damaged, or defective material.
2. Inspect the interior of all pipe and fittings and remove any foreign material from the pipe interior before the pipe is moved into final position.
3. Perform field-cutting of pipes, where required, with a machine specifically designed for cutting pipe. Make cuts without damage to pipe, so as to leave a smooth end at right angles to the axis of pipe. Taper cut ends and smooth sharp edges. Flame cutting is not allowed.
4. Do not lay pipe until the Construction Manager has verified the bedding conditions.
5. Install HDPE pipe and fittings in accordance with the Manufacturer's recommendations and the requirements of this Section.
6. Install pipe and fittings to the lines and grades shown on the Construction Drawings.
7. Place and compact embedment fill and trench backfill material as shown on the Construction Drawings in accordance with Section 02215.
8. Provide all necessary adapters and/or fittings required when connecting different types and sizes of pipe or when connecting pipe made by different manufacturers.

- B. Install underground warning tape in accordance with Section 02215.

### **3.04 HDPE PIPE JOINTS, FITTINGS, AND APPURTENANCES CONNECTIONS**

- A. Qualify personnel performing pipe joining as specified in this Section.

#### **B. Weather Conditions for Joining:**

1. Do not join HDPE pipes and fittings at ambient temperatures below 40 Fahrenheit (F) or above 104 F, unless authorized in writing by the Construction Manager. For cold (<40 F) or hot (>104 F) weather joining, use the additional methods authorized in writing by the Construction Manager.
2. Measure ambient temperatures at fusion machine.
3. Do not join HDPE pipe and fittings during any precipitation, in the presence of heavy fog, dew, or areas of ponded water.

- C. Prior to joining, clean moisture, dust, dirt, debris of any kind, and foreign material from the joint area.
- D. Joining equipment shall be approved for the applicable field joining processes which are thermal butt fusion and electrofusion. Fusion-welding apparatus shall be automated devices equipped with gauges giving the applicable temperatures and pressures.
- E. Make trial butt fusion joints on spool pieces of HDPE pipe to verify that joining conditions are adequate. Conduct trial joints on the same material to be installed and under similar field conditions as production joints. Conduct trial joining at the beginning of each day, and at least once each day for each fusion apparatus used that day. Also, each joiner shall make at least one trial joint each day. Conduct trial joining under the same conditions as the actual joining. Prepare trial joints that are at least 2 feet long with the joint at the midpoint.
- F. Weld HDPE carrier and containment pipes with thermal butt-fusion joints or Electrofusion adapters as indicated on the Construction Drawings. Fabricate joints in strict compliance with ASTM D 2657, ASTM F 1055, and Manufacturer's recommendations.
- G. Install flanged connections of HDPE pipe and fittings as follows:
  - 1. Thermal butt-fuse HDPE flange connection (flange adapter) to HDPE pipe.
  - 2. Use Type 316 stainless steel lap joint flange. Outside diameter and drillings shall comply with American National Standards Institute (ANSI) B16.1.
  - 3. Use Type 316 stainless steel flange bolts, nuts, and washers that meet the requirements of ANSI B16.1. Lubricate bolt threads prior to attaching nuts. Tighten bolts to a torque of  $100 \pm 5$  foot-pounds.
- H. Bolt HDPE flange adapter and stainless steel lap joint flanges at the ambient temperature of the surrounding soil to prevent relaxation of the flange bolts and loosening of the joint due to thermal contraction of the polyethylene. Draw bolts up evenly and in line. Retighten bolts 1 and 4 hours after initial tightening.

### **3.05 FIELD TESTING AND INSPECTION**

- A. Notify the CQC Consultant a minimum of 24 hours in advance of any pipe testing or pipe inspection. CQC Consultant will observe pipe testing in accordance with the Construction Quality Assurance Plan referenced in Part 9 of the Contract Documents.

B. HDPE Pipe and Fittings Hydrostatic Testing:

1. Pressure test all installed HDPE solid wall, carrier, and containment pipe prior to placing fill over the pipe.
2. Test HDPE solid wall and carrier pipe at 120 psi internal pressure. Test pipes in accordance with ASME B31.9 §937.1 through §937.3.
3. Test HDPE containment pipe at 15 psi internal pressure. Test containment pipe in accordance with ASME B31.9 §937.1 through §937.3.
4. Test pipes at the required internal pressure for a minimum of one hour after the pressure in the pipe has stabilized. The test duration does not include the initial expansion phase after the pipe is first pressurized. The duration of the expansion phase shall be as recommended by the Manufacturer.
5. Identify any leaks, remove the water, and make repairs to the pipe.
6. Retest the pipe until acceptance criteria are achieved in accordance with the approved procedures for hydrostatic testing prior to placing backfill over the pipe.
7. Test gauges shall be calibrated within one year of date of test. Calibration shall be traceable to national or industry recognized standards whenever possible.
8. Acceptance criteria for hydrostatic testing is zero leakage for the stabilized pressure for the minimum duration of the test.
9. Temperature correction shall be as recommended by the pipe Manufacturer.
10. Provide details on type of equipment, pipe fittings, and instrumentation to be used for the hydrostatic testing.

C. Contractor may substitute air testing in lieu of hydrostatic testing if approved in writing by the Construction Manager. Submit detailed work plan for review and approval by the Construction Manager.

D. HDPE Pipe Inspection:

1. Inspect the HDPE pipe before and after joining for evidence of defects, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the HDPE pipe shall be clean at the time of inspection. Wipe or wash the HDPE pipe surface if surface contamination inhibits inspection.
2. Inspect fusion joints for evidence of excess or insufficient bead size, contamination, offset, or any other evidence of inadequate joining.
3. Following installation of the protective layer, inspect the LCS, redundant LCS, and LDS carrier pipes using a video camera for a minimum distance of at least 100 feet inside the cell beyond the liner penetration in the presence of the CQC Consultant. Provide the completed inspection video to the CQC Consultant.
4. Repair any pipe sections where pipe diameter deflection from vertical is greater than 4 percent.



E. Defects and Repairs:

1. Repair Procedures:

- a. Repair any portion of the HDPE pipe exhibiting a flaw, or poor quality fusion joints by removing the bad joint or pipe section and replacing with a new pipe section. A flaw or poor quality is indicated by evidence of excess or insufficient bead size, contamination, offset, or any other evidence of inadequate joining
- b. When making repairs, satisfy the following:
  - (1) clean and dry all pipe surfaces immediately prior to repair;
  - (2) only use approved fusion equipment; and
  - (3) extend repairs at least 12 inches in all direction beyond the extent of the defect.

2. Repair Verification:

- c. Inspect each repair using the methods described in the this Section. Re-repair areas that fail the inspection.

**3.06 SURVEY CONTROL**

- A. Survey location and elevation of the HPDE pipe and appurtenances in accordance with Section 02100.
- B. Survey the top of HDPE containment pipe on no greater than 50-foot centers and at liner penetration boxes in accordance with Section 02100.

**3.07 TOLERANCES**

- A. Install all HDPE pipes to within  $\pm 0.1$  feet of bottom of pipe elevations of the containment pipes as indicated on the Construction Drawings.
- B. Provide positive slope of gravity lines at all locations to within  $\pm 10$  percent of the value indicated on the Construction Drawings.

**TABLE 02605-1**  
  
**REQUIRED PROPERTIES AND RANGES**  
**HDPE PIPE AND FITTINGS**

| Properties                          | Cell Range | Qualifiers | Units              | Specified Values      | Test Method                         |
|-------------------------------------|------------|------------|--------------------|-----------------------|-------------------------------------|
| Specific Gravity                    | 3          | minimum    | N/A                | 0.941                 | ASTM D 1505                         |
| Melt Flow Index                     | 4          | minimum    | g/10 min           | 0.15                  | ASTM D 1238<br>(Condition 190/2.16) |
| or                                  | 5          | range      | g/10 min           | 0.15 to 4.0           | ASTM D 1238<br>(Condition 190/21.6) |
| Flexural Modulus                    | 5          | minimum    | lb/in <sup>2</sup> | 110,000               | ASTM D 790                          |
| Tensile Strength                    | 4          | minimum    | lb/in <sup>2</sup> | 3,000                 | ASTM D 638                          |
| Environmental Stress<br>Crack       | 3          | minimum    | hrs                | F <sub>20</sub> > 192 | ASTM D 1693                         |
| Hydrostatic Design Basis<br>at 73 F | 4          | minimum    | lb/in <sup>2</sup> | 1,600                 | ASTM D 2837                         |
| UV Stabilizer                       | C          | minimum    | % Carbon<br>Black  | 2                     | ASTM D 1603                         |

[END OF SECTION]